Description

POWER CONTROL FOR A MOBILE RADIO COMMUNICATION SYSTEM

This invention relates to a communications system, particularly to a Universal Mobile Telecommunications System (UMTS), a method for transmitting data in a communications system, and a base station system.

The transmitted data at the base station of a 3GPP W-CDMA (FDD) cellular radio system can be divided into time continuous traffic (DCH, CCH) and burst like control data, which is in particular the synchronization channel (SCH) [2]. The SCH is time multiplexed with the primary common control physical channel (P-CCPCH). Traditional network configuration assumes equal power (transmit power) for SCH and P-CCPCH such that the sum power level (also denoted as "total transmit power of the used channels") is constant over time. This situation is illustrated in figure 1. "BS- Power" means the transmit power at the base station. Please note that the CDMA system capacity is limited by its self interference, which is in particular caused by all non desired users and the control channels. Thus the capacity is given by the ratio of area of the DCH block divided by the total area in figure 1. The sum transmit power of the dedicated downlink channels (also denoted as "transmit power of dedicated channels", "total transmit power of the dedicated downlink channels") is regularly constant within one time slot.

Currently, it is a standard requirement that also the DCH-power of each traffic channel is either constant during the whole slot (time slot) or may change with fixed power steps at more or less random time instances within the slot. These

instances are random in time because of the many different DCH slot formats and the additional timing offset for each DCH relative to the SCH [2]. This is also illustrated in figure 1.

In the context of "identification of a new cell", it has been recognised that an increased power level for the SCH compared to the P-CCPCH is necessary. This is meanwhile reflected in a respective change of standard requirements (see [3], [4]).

Figure 1 and figure 2 show a dashed line, which represents the maximum power amplifier (PA) level at the base station (BS) (also denoted as "amplifier power limit", "maximum power limit"). This level is an important design parameter of a base station since it has significant impact on cost, size and power consumption of the whole base station.

Currently the 3GPP standard allows an increase of the SCH power only in a way as depicted in figure 2. A discontinuity of the transmitted power (also denoted as "total transmit power of the used channels", "total output power at the base station power amplifier", "sum power") over time is introduced. Two power budged options are shown in figure 2:

Option one on the left hand side keeps the sum power always below the "amplifier power limit". The spectral distortion of the BS transmit signal due to discontinuity can be neglected. The system capacity, however, is considerably reduced, because the total DCH-power (area of the DCH block) compared to the sum power is reduced.

Option two on the right hand side of figure 2 exploits the full mean power the base station (sum area of all channels corresponds to "maximum mean power") and the capacity loss is relatively low . The peak power, however, is increased and due to the non-linearity of the BS power amplifier, spectral distortion of the transmit signal occurs.

The change of requirements, which demands for increased SCH-level, is quite new. Based on the current W-CDMA standard known solutions are shown in figure 2. This means either considerable system capacity loss or more expensive, larger and less efficient power amplifier.

Based on the foregoing description it is an object of the invention to provide a communications system, a method for transmitting data and a base station system, that enable a reliable synchronisation in a communications system.

The object of the invention will be achieved with a communications system, a method for transmitting data and a base station system, which are defined by what is disclosed in the appended independent claims. Advantageous embodiments of the present invention will be presented in the dependent claims. Further developments of the method claim and the base station system claim corresponding to the dependent claims of the communications system claim also lie within the scope of the invention.

The reduction of the transmit power of the dedicated channels can be different for different dedicated channels, particularly in dependence on the different quality of service requirements assigned to the dedicated channels.

Each dedicated channel can be related to one mobile station. Some dedicated channels can be related to the same mobile station.

Each common channel can be related to at least two mobile stations.

Of course it lies also within the scope of this invention to execute the invention only within certain parts or base station systems of a communications system or within certain predefined time intervals.

Preferably the plurality of common channels (P-CCPCH, CCH) including a primary common control physical channel (P-CCPCH) and/or the plurality of dedicated channels (DCH) and/or the synchronisation channel (SCH) are realised by a certain base station or base station system and the transmit power of dedicated channels (DCH) being reduced during the transmission of the synchronisation channel (SCH) is the total transmit power of the dedicated downlink channels realised by this base station or base station system.

Of course it lies within the scope of this invention, that other common channels or dedicated channels within the communications system are realised by other base stations or base station systems. One, more or all of these base stations or base stations systems can also be arranged such, that the transmit power of dedicated channels (DCH) being reduced during the transmission of a synchronisation channel (SCH) by one of these base stations or base station systems is the total transmit power of the dedicated downlink channels realised by this base station or base station system.

One special idea underlying an embodiment of the invention is to keep the sum power over all physical channels at a constant level and to decrease the DCH power during SCH-transmission for that purpose.

Advantages gained by the traffic channel cutback (DCH power reduction during SCH transmission) are:
Traffic channel cut back (DCH power reduction during SCH transmission) during SCH transmission balances the sum power along the slot. This improves the spectral behaviour of the (power limited) amplifier and makes the power amplifier cheaper, smaller and more efficient. The system capacity degradation is relatively low since the total power assigned to DCH-traffic is high.

In the following, the invention will be described by means of preferred embodiments with reference to the accompanying drawings, in which:

Figure 1 shows traditional power budget of W-CDMA physical channels at the base station (prior art);

Figure 2 shows power distribution of W-CDMA physical channels at the base station to cope with new requirement for cell (prior art);

Figure 3 shows a schematic view of a reduction of the DCH transmit power ("Traffic Channel Cutback").

The graph in figure 3 shows the transmit power (BS power) of the transmit amplifier of a base station over time.

The power of a plurality of common channels (P-CCPCH, CCH) including a primary common control physical channel (P-CCPCH) is shown as well as the sum transmit power of the dedicated downlink channels (also denoted as "transmit power of dedicated channels") (DCH). Particularly these channels are realised by one base station.

The transmit power of the synchronisation channel (SCH) exceeds the transmit power of the primary common control physical channel (P-CCPCH), that is transmitted time multiplexed with the synchronisation channel (SCH).

The sum transmit power of the dedicated downlink channels (also denoted as "transmit power of dedicated channels") (DCH) is reduced during the transmission of the synchronisation channel (SCH).

The communications system is a Wide-Band-CDMA-System (W-CDMA) in particular a Universal Mobile Telecommunications System (UMTS), and the common channels and the dedicated channels are transmitted code multiplexed.

The reduction of the transmit power of dedicated channels (DCH) is such that the total transmit power of the used channels (total output power at the base station power amplifier) is not above an amplifier power limit and preferably substantially constant.

The transmit power of the dedicated channels is reduced during the transmission of the synchronisation channel (SCH) by the difference between the transmit power of the synchronisation channel (SCH) and the transmit power of the primary common control physical channel (P-CCPCH).

The transmit power of dedicated channels (DCH) is reduced at the beginning of the synchronisation channel (SCH), and the transmit power of dedicated channels (DCH) is increased at the end of the synchronisation channel (SCH).

The reduction of the transmit power of dedicated channels (DCH) during the transmission of the synchronisation channel (SCH) is triggered in dependence on information about the synchronisation channel timing. This information is preferably stored in a memory unit of or assigned to the base station system.

The reduction of the transmit power of dedicated channels is such that the total transmit power of the used channels is substantially constant and not above an amplifier power limit just before the transmission of the synchronisation channel, just after the transmission of the synchronisation channel and during the transmission of the synchronisation channel.

It lies also within the scope of this invention to change the total transmit power of the used channels later for example due to lower traffic demands.

The sum transmit power of the downlink dedicated channels (DCH) is reduced during the transmission of the synchronisation channel (SCH) particularly in order to keep the total output power at the base station power amplifier below a maximum power limit.

With regard to figure 3 it should be noted, that the signal level reduction occurs asynchronously to the DCH slot and field boundaries.

There are the following different alternatives and modifications of the basic idea, which lie also within the scope of this invention:

- Switching between fully loaded and partially loaded system: DCH power truncation (DCH power reduction during SCH transmission) is turned off in case of an only partially loaded system: The spectral degradation due to sum power bursts (SCH) are not critical and individual link quality can be kept optimum instead.

- Selective reduction of DCH level during SCH transmission based on service specific quality requirements or certain DCH-fields.

A communications system for realising the invention shows one or more base station systems that are connected with each other and/or with other communications systems via one or more mobile switching centres. Data are transmitted via downlink channels from the base station system to mobile stations and via uplink channels from mobile stations to the base station system. Thus a communication between mobile stations is enabled. The base station systems show a processing unit that is arranged such, that the primary common control physical channel (P-CCPCH) and the synchronisation channel (SCH) are transmitted time multiplexed, and that the transmit power of dedicated channels (DCH) is reduced during the transmission of the synchronisation channel (SCH).

References:

[1] 3GPP TS25.101 V3.13.0 (2003-03): UE Radio Transmission and Reception (FDD)

[2] 3GPP TS25.211 V3.12.0 (2002-09): Physical channels and mapping of transport channels onto physical channels (FDD)

[3] 3GPP TS25.133 V3.13.0 (2003-03): Requirements for Support of Radio Resource Management (FDD)

[4] TSG-RAN WG4#25, R4-021580: On Cell Identification in Multi-Path Fading Conditions